Functional relevance of correlated neural inputs in the regulation of antagonist activity during submaximal isometric fingers flexion tasks

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Antagonist muscle activity plays crucial roles during voluntary contraction, especially in joint stiffness, stability and impedance. Previous studies evidenced common neural inputs as a mechanism responsible for the coordinated activation of hand muscles, but its functional relevance to the modulation of antagonist activity remains to be established. Correlated neural inputs can be quantified by across-muscle coherence between electromyographic (EMG) signals. Interestingly, the contribution of hand extensors differs according to hand configuration for a same functional demand to flex the fingers. The aim of this study was to compare EMG-EMG coherence during fingers flexion performed in different hand configurations while controlling agonist muscle force to gain insights into neural mechanisms underlying the regulation of antagonist muscles activity.

Twenty-four participants performed submaximal isometric fingers flexions in two hand configurations: power grip (*Power*) and finger-pulling (*Pull*). The required net force was set based on pilot results obtained from hand musculoskeletal modeling, so that mean agonist muscle force was 150 N in both configurations. EMG-EMG coherence analysis was performed in beta-range (15-35 Hz) between key wrist and fingers flexors and extensors muscle pairs. Wilcoxon tests were used to identify differences in EMG-EMG coherence at comparable net force value and force level between hand configurations ($\alpha = 0.05$).

Our main results showed higher magnitude of beta EMG-EMG coherence for FCR/ECR, FCR/EDC, FDS/ECR, FDS/EDC and FCR/FDS muscle pairs in *Power* than in *Pull*, while no significant difference was found for ECR/EDC (Fig. 1).

These results supported a relationship between changes in EMG-EMG coherence and the modulation of antagonist muscles activity at similar agonist and both absolute and relative force values between hand configurations. Our findings suggest the involvement of correlated neural inputs as a functional mechanism that could govern the regulation of antagonist muscles activity according to task constraints.

Keywords: antagonist activity, wavelet-based intermuscular coherence, muscle tensions, neural control

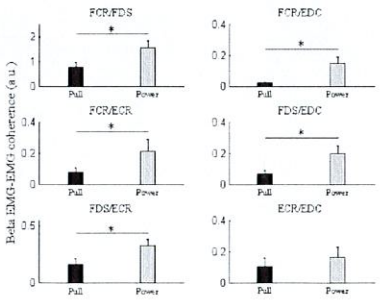

Figure 1: EMG-EMG coherence values in the beta-range (15-35 Hz, β) for FCR/FDS, FCR/EDC, FCR/ECR, FDS/EDC, FDS/ECR and ECR/EDC muscle pairs during submaximal voluntary isometric flexion contraction of the fingers in *Pull* and *Power*. FCR, FDS, ECR and EDC stand for flexor carpi radialis ,flexor digitorum superficialis, extensor carpi radialis and extensor digitorum commonis, respectively. * Indicates a significant Configuration effect.